CLAIMS

1. An apparatus, comprising:
a first nanoscale wire; and
a second nanoscale wire proximate the first nanoscale wire, the second nanoscale wire constructed and arranged to generate amplified stimulated emission of radiation based on at least one electric signal provided to the first nanoscale wire.

2. The apparatus of claim 1, wherein at least one of the first and second nanoscale wires includes at least one cadmium sulfide nanoscale wire.

3. The apparatus of claim 1, wherein at least one of the first and second nanoscale wires includes at least one cadmium selenide nanoscale wire.

4. The apparatus of claim 1, wherein at least one of the first and second nanoscale wires includes at least one zinc selenide nanoscale wire.

5. The apparatus of claim 1, wherein at least one of the first and second nanoscale wires includes at least one zinc oxide nanoscale wire.

6. The apparatus of claim 1, wherein at least one of the first and second nanoscale wires includes at least one gallium nitride nanoscale wire.

7. The apparatus of claim 1, wherein at least one of the first and second nanoscale wires includes at least one indium phosphide nanoscale wire.

8. The apparatus of claim 1, wherein the second nanoscale wire is constructed and arranged to generate amplified stimulated emission of visible radiation.

9. The apparatus of claim 1, wherein the second nanoscale wire is constructed and arranged to generate amplified stimulated emission of ultraviolet radiation.

10. The apparatus of claim 1, wherein the second nanoscale wire is constructed and arranged to generate amplified stimulated emission of infrared radiation.

11. The apparatus of claim 1, wherein at least one of the first and second nanoscale wires has a diameter in a range of approximately 50 nanometers to 1000 nanometers.

12. The apparatus of claim 11, wherein at least one of the first and second nanoscale wires has a diameter in a range of approximately 80 nanometers to 200 nanometers.

13. The apparatus of claim 1, wherein the second nanoscale wire is constructed and arranged as an optical cavity.

14. The apparatus of claim 13, wherein the second nanoscale wire is constructed and arranged as a Fabry-Perot resonator.

15. The apparatus of claim 14, wherein the second nanoscale wire is cleaved so as to provide two end reflectors that define the Fabry-Perot resonator.

16. The apparatus of claim 14, wherein the Fabry-Perot resonator includes two end reflectors formed by solution phase sonication of the second nanoscale wire.

17. The apparatus of claim 15, wherein the second nanoscale wire is constructed and arranged such that at least one of the two end reflectors of the Fabry-Perot resonator includes at least one Bragg grating.

18. The apparatus of claim 17, wherein the at least one Bragg grating is formed by axial composition modulation of the second nanoscale wire.

19. The apparatus of claim 13, wherein the second nanoscale wire is constructed and arranged both as the optical cavity and a gain medium.

20. The apparatus of claim 1, wherein the first nanoscale wire and the second nanoscale wire form a p-n junction.

21. The apparatus of claim 20, wherein the first nanoscale wire and the second nanoscale wire are constructed and arranged to form a crossed nanoscale wire structure.

22. The apparatus of claim 20, wherein the first nanoscale wire comprises an n-type semiconductor material.

23. The apparatus of claim 21, wherein the second nanoscale wire comprises a p-type semiconductor material.

24. The apparatus of claim 20, wherein the apparatus is constructed and arranged such that the at least one electric signal is applied as a voltage between the first nanoscale wire and the second nanoscale wire.

25. The apparatus of claim 20, wherein the first nanoscale wire is a cadmium sulphide nanoscale wire.

26. The apparatus of claim 20, wherein the second nanoscale wire is a silicon nanoscale wire.

27. The apparatus of claim 25, wherein the first nanoscale wire comprises an n-type semiconductor material.

28. The apparatus of claim 25, wherein the second nanoscale wire comprises a p-type semiconductor material.

29. The apparatus of claim 25, wherein the cadmium sulphide nanoscale wire has a doping concentration on the order of approximately $10^{19}/cm^3$.

30. The apparatus of claim 25, wherein the silicon nanoscale wire has a doping concentration on the order of approximately $10^{18}/cm^3$ to $10^{19}/cm^3$.

31. The apparatus of claim 25, wherein the cadmium sulphide nanoscale wire is constructed and arranged to form an optical cavity.

32. The apparatus of claim 25, wherein the cadmium sulphide nanoscale wire is constructed and arranged as a Fabry-Perot resonator.

33. The apparatus of claim 32, wherein the cadmium sulphide nanoscale wire is cleaved so as to provide two end reflectors that define the Fabry-Perot resonator.

34. The apparatus of claim 33, wherein the two end reflectors are formed by solution phase sonication of the cadmium sulphide nanoscale wire.

35. The apparatus of claim 33, wherein the cadmium sulphide nanoscale wire is constructed and arranged such that at least one of the two end reflectors includes at least one Bragg grating.

36. The apparatus of claim 35, wherein the at least one Bragg grating is formed by axial composition modulation of the at least one nanoscale wire.

37. The apparatus of claim 25, wherein the cadmium sulphide nanoscale wire is constructed and arranged both as the optical cavity and a gain medium.

38. An apparatus, comprising:
at least one nanoscale wire constructed and arranged to generate amplified stimulated emission of radiation, the at least one nanoscale wire including a first type semiconductor material; and
a substrate,
wherein the apparatus is constructed and arranged such that at least first carrier

types are injected along at least a portion of a length of the at least one nanoscale wire, in response to an electric signal from the substrate, to facilitate generation of the amplified stimulated emission of the radiation.

39. The apparatus of claim 38, wherein the first type semiconductor material is an n-type semiconductor material.

40. The apparatus of claim 38, wherein the first carrier types are holes.

41. The apparatus of claim 38, wherein the first type semiconductor material is a p-type semiconductor material.

42. The apparatus of claim 38, wherein the first carrier types are electrons.

43. The apparatus of claim 38, further comprising at least one second type semiconductor material electrode, wherein the at least one nanoscale wire is arranged with respect to the at least one second type semiconductor material electrode to form at least one p-n junction, such that, in response to the electric signal, at least some of the first carriers are injected along at least the portion of the length of the at least one nanoscale wire via the at least one second type semiconductor material electrode.

44. The apparatus of claim 43, wherein:
the first type semiconductor material is an n-type semiconductor material;
the second type semiconductor material is a p-type semiconductor material; and
the first carrier types are holes.

45. The apparatus of claim 43, wherein:
the first type semiconductor material is a p-type semiconductor material;
the second type semiconductor material is an n-type semiconductor material; and
the first carrier types are electrons.

46. The apparatus of claim 43, further comprising a second type semiconductor layer disposed on the substrate,
wherein the at least one second type semiconductor material electrode is defined in the second type semiconductor layer.

47. The apparatus of claim 46, wherein:
the first type semiconductor material is a p-type semiconductor material;
the second type semiconductor material is an n-type semiconductor material;
the second type semiconductor layer is an n-type semiconductor layer; and
the first carrier types are electrons.

48. The apparatus of claim 46, wherein:
the first type semiconductor material is an n-type semiconductor material;
the second type semiconductor material is a p-type semiconductor material;
the second type semiconductor layer is a p-type semiconductor layer; and
the first carrier types are holes.

49. The apparatus of claim 48, wherein:
the at least one nanoscale wire is formed of cadmium sulfide; and
the at least one p-type electrode is formed of doped silicon.

50. The apparatus of claim 49, wherein the doped silicon has a doping concentration of approximately $4 \times 10^{19}/cm^3$.

51. The apparatus of claim 48, further comprising at least one metal layer in contact with the at least one nanoscale wire to provide for the injection of electrons into the at least one nanoscale wire.

52. The apparatus of claim 51, further comprising at least one insulating layer disposed between at least a portion of the at least one nanoscale wire and the at least one metal layer.

53. The apparatus of claim 52, wherein the at least one insulating layer includes aluminum oxide.

54. The apparatus of claim 38, wherein the at least one nanoscale wire includes at least one cadmium selenide nanoscale wire.

55. The apparatus of claim 38, wherein the at least one nanoscale wire includes at least one zinc selenide nanoscale wire.

56. The apparatus of claim 38, wherein the at least one nanoscale wire includes at least one zinc oxide nanoscale wire.

57. The apparatus of claim 38, wherein the at least one nanoscale wire includes at least one gallium nitride nanoscale wire.

58. The apparatus of claim 38, wherein the at least one nanoscale wire includes at least one indium phosphide nanoscale wire.

59. The apparatus of claim 38, wherein the at least one nanoscale wire is constructed and arranged to generate amplified stimulated emission of visible radiation.

60. The apparatus of claim 38, wherein the at least one nanoscale wire is constructed and arranged to generate amplified stimulated emission of ultraviolet radiation.

61. The apparatus of claim 38, wherein the at least one nanoscale wire is constructed and arranged to generate amplified stimulated emission of infrared radiation.

62. The apparatus of claim 38, wherein the at least one nanoscale wire has a diameter in a range of approximate 50 nanometers to 1000 nanometers.

63. The apparatus of claim 62, wherein the at least one nanoscale wire has a diameter in a range of approximate 80 nanometers to 200 nanometers.

64. The apparatus of claim 38, wherein the at least one nanoscale wire is constructed and arranged as an optical cavity.

65. The apparatus of claim 38, wherein the at least one nanoscale wire is constructed and arranged as a Fabry-Perot resonator.

66. The apparatus of claim 69, wherein the at least one nanoscale wire is cleaved so as to provide two end reflectors that define the Fabry-Perot resonator.

67. The apparatus of claim 66, wherein the two end reflectors are formed by solution phase sonication of the at least one nanoscale wire.

68. The apparatus of claim 66, wherein the at least one nanoscale wire is constructed and arranged such that at least one of the two end reflectors includes at least one Bragg grating.

69. The apparatus of claim 68, wherein the at least one Bragg grating is formed by axial composition modulation of the at least one nanoscale wire.

70. The apparatus of claim 38, wherein the at least one nanoscale wire includes:
a core having a first type semiconductor material; and
at least one shell having a second type semiconductor material so as to form at least one p-n junction with the core.

71. The apparatus of claim 70, wherein:
the first type semiconductor material is an n-type semiconductor material;
the second type semiconductor material is a p-type semiconductor material; and
the first carrier types are holes.

72. The apparatus of claim 70, wherein:
the first type semiconductor material is a p-type semiconductor material;

the second type semiconductor material is an n-type semiconductor material; and the first carrier types are electrons.

73. The apparatus of claim 70, wherein the core is formed of cadmium sulfide.

74. The apparatus of claim 70, wherein the core is formed of cadmium selenide.

75. The apparatus of claim 70, wherein the core is formed of zinc sulfide.

76. The apparatus of claim 70, wherein the core is formed of zinc oxide.

77. The apparatus of claim 70, wherein the core is formed of gallium nitride.

78. The apparatus of claim 70, wherein the core is formed of indium phosphide.

79. The apparatus of claim 70, wherein the at least one nanoscale wire is constructed and arranged to generate amplified stimulated emission of visible radiation.

80. The apparatus of claim 70, wherein the at least one nanoscale wire is constructed and arranged to generate amplified stimulated emission of ultraviolet radiation.

81. The apparatus of claim 70, wherein the at least one nanoscale wire is constructed and arranged to generate amplified stimulated emission of infrared radiation.

82. The apparatus of claim 70, wherein the at least one nanoscale wire has a diameter in a range of approximate 50 nanometers to 1000 nanometers.

83. The apparatus of claim 82, wherein the at least one nanoscale wire has a diameter in a range of approximate 80 nanometers to 200 nanometers.

84. The apparatus of claim 70, wherein the at least one nanoscale wire is constructed and arranged as an optical cavity.

85. The apparatus of claim 84, wherein the at least one nanoscale wire is constructed and arranged as a Fabry-Perot resonator.

86. The apparatus of claim 85, wherein the at least one nanoscale wire is cleaved so as to provide two end reflectors that define the Fabry-Perot resonator.

87. The apparatus of claim 86, wherein the two end reflectors are formed by solution phase sonication of the at least one nanoscale wire.

88. The apparatus of claim 86, wherein the at least one nanoscale wire is constructed and arranged such that at least one of the two end reflectors includes at least one Bragg grating.

89. The apparatus of claim 88, wherein the at least one Bragg grating is formed by axial composition modulation of the at least one nanoscale wire.

90. A method of generating amplified stimulated emission of radiation, comprising an act of:
applying an electrical signal from a first nanoscale wire to a second nanoscale wire formed as an optical resonator.

91. The method of claim 90, wherein the first and second nanoscale wires together define a p-n junction.

92. A method of generating amplified stimulated emission of radiation, comprising:
sufficiently injecting charge carriers from a first nanoscale wire into a second nanoscale wire formed as an optical resonator.

93. A method of fabricating a nanoscale wire laser, comprising:
a) forming a first nanoscale wire into an optical cavity;
b) forming at least one p-n junction in the optical cavity; and

c) contacting the first nanoscale wire with a second nanoscale wire.

94. The method of claim 93, wherein the act a) includes an act of:
a1) forming the optical cavity as a Fabry-Perot resonator.

95. The method of claim 94, wherein the act a1) includes an act of:
a2) cleaving the first nanoscale wire so as to provide two end reflectors that define the Fabry-Perot resonator.

96. The method of claim 94, wherein the act a1) includes an act of:
a2) forming the two end reflectors by solution phase sonication of the first nanoscale wire.

97. The method of claim 94, wherein the act a1) includes an act of:
a2) forming at least one of the two end reflectors as at least one Bragg grating.

98. The method of claim 97, wherein the act a2) includes an act of:
a3) forming the at least one Bragg grating by axial composition modulation of the first nanoscale wire.

99. The method of claim 93, wherein the act a) includes an act of:
forming the first nanoscale wire both as the optical cavity and a gain medium.

100. The method of claim 93, wherein the act b) includes an act of:
forming the at least one p-n junction so as to support carrier injection in the optical cavity in response to an electric signal.

101. The method of claim 93, wherein act a) includes forming the first nanoscale wire from a first type semiconductor material.

102. The method of claim 93, wherein the second nanoscale wire is formed from a second type semiconductor material.

103. The method of claim 93, wherein act c) includes an act of: arranging the first nanoscale wire and the second nanoscale wire to form a crossed nanoscale wire structure.

104. The method of claim 101, wherein the first type semiconductor material is an n-type semiconductor material.

105. The method of claim 102, wherein the second type semiconductor material is a p-type semiconductor material.

106. The method of claim 104, wherein the first nanoscale wire is a cadmium sulphide nanoscale wire.

107. The method of claim 105, wherein the second nanoscale wire is a silicon nanoscale wire.

108. A method of fabricating a nanoscale laser comprising:
a) forming at least one nanoscale wire from a first type semiconductor material;
b) forming the at least one nanoscale wire into an optical cavity; and
c) coupling the at least one nanoscale wire to at least one electrode formed from a second type semiconductor material.

109. The method of claim 108, wherein the first type semiconductor material is an n-type semiconductor material.

110. The method of claim 108, wherein the second type semiconductor material is a p-type semiconductor material.

111. The method of claim 108, wherein the first type semiconductor material is a p-type semiconductor material.

112. The method of claim 108, wherein the second type semiconductor material is an n-type semiconductor material.

113. The method of claim 108, further comprising an act of: forming the at least one electrode in a semiconductor layer coupled to a substrate.

114. The method of claim 113, further comprising an act of: forming at least one metal layer in contact with the at least one nanoscale wire.

115. The method of claim 114, further comprising an act of: forming at least one insulating layer disposed between at least a portion of the at least one nanoscale wire and the at least one metal layer.

116. The method of claim 115, wherein the at least one insulating layer includes a layer of aluminum oxide.

117. A method of fabricating a nanoscale wire optical cavity, comprising: a) forming at least one Bragg grating on at least one nanoscale wire.

118. The method of claim 117, wherein the act a) includes an act of: a1) forming the optical cavity as a Fabry-Perot resonator.

119. The method of claim 118, wherein the act a1) includes an act of: a2) cleaving the at least one nanoscale wire so as to provide two end reflectors that define the Fabry-Perot resonator.

120. The method of claim 119, wherein the act a2) includes an act of: a3) forming the two end reflectors by solution phase sonication of the at least one nanoscale wire.

121. The method of claim 118, wherein the act a1) includes an act of:

a2) forming at least one of the two end reflectors as the at least one Bragg grating.

122. The method of claim 121, wherein the act a2) includes an act of: a3) forming the at least one Bragg grating by axial composition modulation of the at least one nanoscale wire.

123. The method of claim 117, wherein the act a) includes an act of: forming the at least one nanoscale wire both as the optical cavity and a gain medium.

124. An apparatus, comprising: an electrical injection laser including two crossed nanoscale wires.

125. The apparatus of claim 124, wherein at least one of the two crossed nanoscale wires is made entirely or in part of at least one material selected from the group consisting of cadmium sulfide, cadmium selenide, zinc selenide, zinc oxide, gallium nitride, indium phosphide, and combinations thereof.

126. A method of generating amplified stimulated emission of radiation, comprising an act of: applying an electric signal along at least a portion of a length of a nanoscale wire formed as an optical resonator.

127. An apparatus, comprising: an electrical injection laser including a nanoscale wire constructed and arranged to receive carriers along at least a portion of a length of the nanoscale wire.

128. The apparatus of claim 127, wherein the nanoscale wire is made entirely or in part of at least one material selected from the group consisting of cadmium sulfide, cadmium selenide, zinc selenide, zinc oxide, gallium nitride, indium phosphide, and combinations thereof.

129. A device, comprising:

a substrate; and

at least one nanoscale wire electrical injection laser integrated with the substrate.